FAMILY OF DISCRETELY SIZED SLICON NANOPARTICLES AND METHOD FOR PRODUCING THE SAME

ABSTRACT

A family of discrete and uniformly sized silicon nanoparticles, including 1 (blue emitting), 1.67 (green emitting), 2.15 (yellow emitting), 2.9 (red emitting) and 3.7 nm (infrared emitting) nanoparticles, and a method that produces the family. The nanoparticles produced by the method of the invention are highly uniform in size. A very small percentage of significantly larger particles are produced, and such larger particles are easily filtered out. The method for producing the silicon nanoparticles of the invention utilizes a gradual advancing electrochemical etch of bulk silicon, e.g., a silicon wafer. The etch is conducted with use of an appropriate intermediate or low etch current density. An optimal current density for producing the family is ~ 10 milli Ampere per square centimeter ($10mA/cm^2$). Higher current density favors 1nm particles, and lower the larger particles. Blue (1nm) particles, if any appreciable quantity exist depending on the selected current density, may be removed by, for example, shaking or ultrasound. After the etch, the pulverized wafer is immersed in dilute HF for a short time, while the particles are still connected to the wafer to weaken the linkages between the larger particles. This may be followed by separation of nanoparticles from the surface of the silicon. Once separated, various methods may be employed to form plural nanoparticles into crystals, films and other desirable forms. The nanoparticles may also be coated or doped. The invention produces the family of a discrete set of sized particles and not a continuous size distribution. Particles may be isolated from the family, i.e., it is possible to produce any one of the sizes of particles from the family after the basic method steps have been executed to produce the family of particles.